LIGHT-EMITTING DEVICE AND ELECTRONIC DEVICE INCLUDING FIRST AND SECOND LIGHT EMITTING ELEMENTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a light-emitting device in which a pixel portion is formed with a light-emitting element including a light-emitting layer between a pair of electrodes, and the light-emitting layer includes an electroluminescent (light-emitting) material. Specifically, the present invention relates to a light-emitting device that can display images on both sides thereof. Further, the present invention also relates to an electronic device in which both sides thereof are display screens.

2. Description of the Related Art

Further, as for electronic devices, particularly, personal digital assistants such as mobile computers, cellular phones, portable game machines, and electric books, higher added value is required as the result of diversification of the intended use. The electronic devices provided with a sub display screen on the opposite side of a normal display screen has been provided recently (Reference 1: Japanese Patent Laid Open No. 2002-101160).

In recent years, a light-emitting device including a light-emitting element as a self luminous type light-emitting element, for example, as an organic EL display, an inorganic EL display and the like, have been researched and developed actively. The organic EL displays, in particular, have the characteristics of high-definition, high response speed, low voltage, and low electric power consumption driving suitable for displaying a moving image since they are self luminous type, a thinned structure and lightweight because of not having a backlight and therefore, draw attraction as a next generation display such as a personal digital assistant.

A light-emitting element in a light-emitting device has a structure in which a light-emitting material containing layer is formed between a pair of an anode and a cathode, one of which is light-transparent. Electroluminescence is emitted from the light-emitting material containing layer by applying an electric field to the anode and the cathode. In this specification, it should be noted that all layers provided between the cathode and the anode are collectively referred to as a light-emitting material containing layer.

In addition, these light-emitting devices adopt a dot matrix method by which light-emitting elements are arranged in matrix form, and driving methods are classified roughly into a passive matrix driving method (a simple matrix method) or an active matrix driving method.

In a display device employing a passive matrix driving method, an anode and a cathode are arranged in a striped-shape and crossed in matrix form, and a light-emitting material containing layer is formed between each electrode at the crossing point to form a pixel. A luminance signal circuit or a control circuit incorporating a shift register is each provided for an anode and a cathode, and a signal voltage is applied to each electrode in time-series manner by using the circuits and the pixel provided at the crossing point is allowed to emit light selectively. When the display device employing a passive matrix driving method is manufactured, the number of manufacturing steps is small and thus, the manufacturing cost can be reduced (Reference 2: Japanese Patent Laid Open No. 2001-155856)

In a display device employing an active matrix driving method, pixels, which are each made up of an anode, a cathode, and a light-emitting material containing layer provided between the anode and the cathode, are arranged in matrix form and a pixel driving element (such as a transistor or a diode) is provided for each pixel. The pixel driving element is allowed to serve as a switch for switching on-and off-states by a scanning signal, a data signal (such as a display signal or a video signal) is transmitted to a pixel electrode of a light-emitting element through the pixel driving element that is on-state, and the data signal is written in the light-emitting element, thereby making the light-emitting element emit light. In the display device employing an active matrix driving method, a pixel driving element is provided for each pixel, and thus the response speed is high. The display device employing an active matrix driving method is suitable for displaying a moving image (Reference 3: Japanese Patent Laid Open No. 2001-013893). Note that a display device employing an active matrix system is mainly adopted in an organic EL display.

However, as for a personal digital assistant provided with a sub display screen in addition to a main display screen, it is necessary to consider not only a volume occupied by plural modules but also a volume occupied by a substrate and the like on which a control IC for driving the modules or the like is mounted. Particularly, in the personal digital assistants that have been provided recently, reduction in weight, thickness, and size is considerably advanced, but they are trades-off to high added value.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above-described problems. It is an object of the present invention to provide a light-emitting device that can be a module occupying a small volume, and electronic devices, typically, personal digital assistants, in which high added value can be obtained by using the light-emitting device.

A light-emitting device according to the present invention has a plurality of light-emitting elements in a pixel, and these light-emitting elements emit light in a direction different from each other and a pixel driving element is provided in one of the light-emitting elements. In other words, as for the plural light-emitting elements provided in a pixel, one of the light-emitting elements is a light-emitting element by an active matrix driving method and the other is a light-emitting element by a passive matrix driving method or a light-emitting element for area color. By this structure, it is possible to emit light independently on front and back sides of one display device, and further, to provide a light-emitting element that can have a function that is needed in each display portion. Typically, it is possible that a display is performed on a main display screen by using an active matrix light-emitting element and a display is performed on a sub display screen by using a passive matrix light-emitting element or a light-emitting element for area color. The sub display screen can be used as a light by making a whole display surface emit light. Further, one light-emitting element covers most of a non-light emission area of the other light-emitting element, and thus, the aperture ratio is much higher than a pixel formed by using a conventional light-emitting element. Therefore, contrast is enhanced and a high-definition display can be performed.

It should be noted that a light-emitting device in this specification includes a light-emitting device and an image display device that use a light-emitting element. Additionally, the followings are included in the light-emitting device: a module where a connector, for example, a flexible printed circuit (FPC), a tape automated bonding (TAB) tape, or a tape carrier package (TCP) is set up onto a light-emitting element; a